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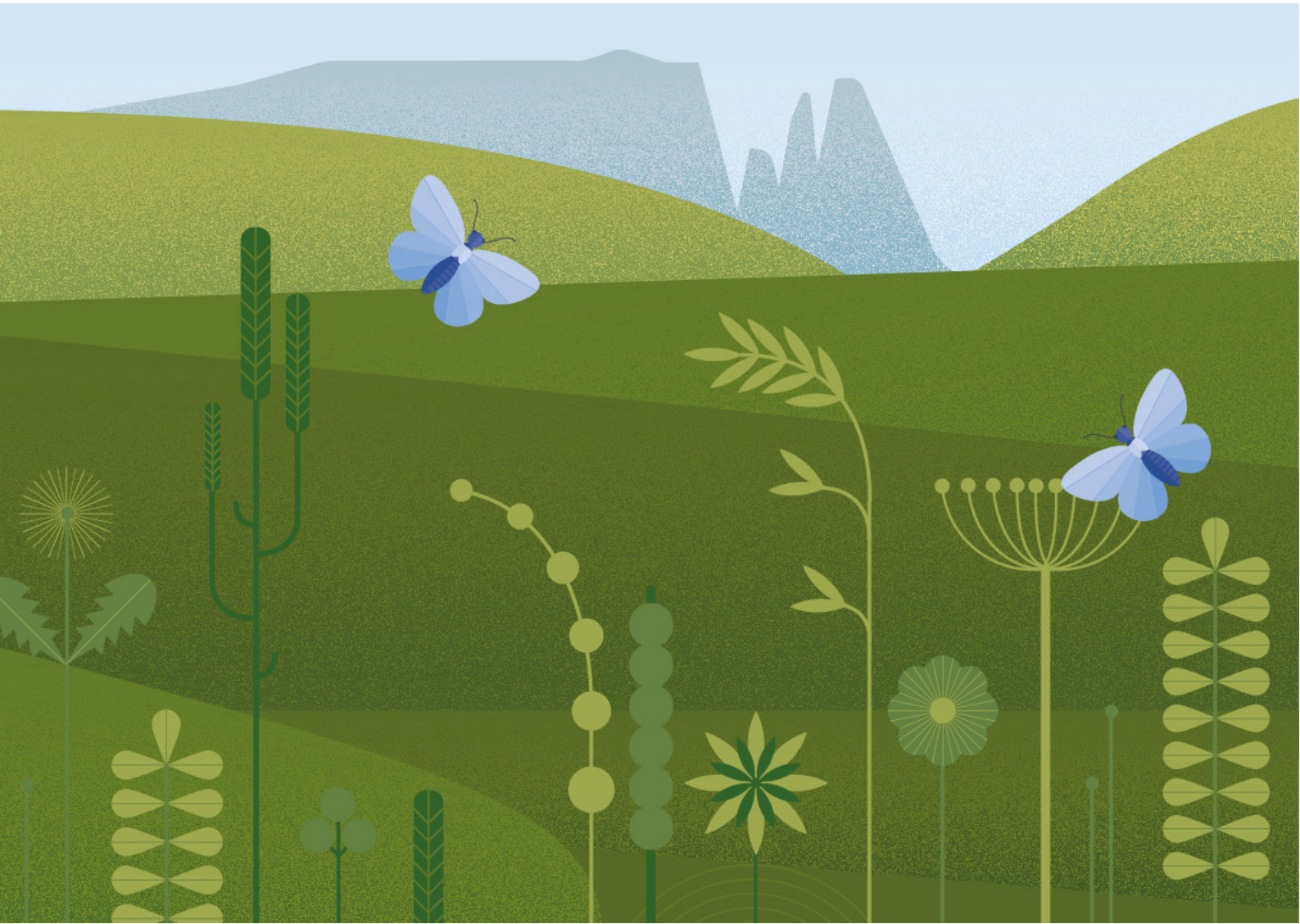

Efficiency of birds as bioindicators for other taxa in mountain grasslands

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Biodiversity loss is a critical global concern, especially in mountain regions where land-use/land-cover (LULC) change and climate warming have significant impacts on species and communities. Effective ecological research and up-to-date biodiversity data are essential to support conservation efforts. However, obtaining this information is often challenging and costly, so bioindicators can serve as surrogates, offering insights into the broader biocenosis. Even birds are considered excellent bioindicators because they occupy various ecological niches and trait spaces. This presentation examines the effectiveness of birds as bioindicators for the diversity of other taxa in a mountain region of the Central Alps, focusing on different grassland types. We conducted surveys of bird communities at 115 sites across a gradient of grasslands, permanent corps and arable areas, comparing these with the diversity of taxa, such as bats, butterflies, grasshoppers, arachnids, and vascular plants. Our objectives were to identify indicator bird species for different agriculturally used LULC types, evaluate cross-community concordance between birds and other taxa, and model the efficiency of bird indices and indicator species as bioindicators of diversity across different habitat types and taxa. We identified specific bird species that serve as indicators for various LULC types and discovered that the efficiency of bird indices and individual species varied by habitat type and taxa. Additionally, we showed that by utilizing a combination of different indices, a more comprehensive understanding of ecosystem functioning can be gained. The results underscore the importance of selecting appropriate bioindicators and indices for conservation planning, biodiversity monitoring and research. Finally, this study provides a framework for using bird-based monitoring programs and bird-derived indices to guide biodiversity conservation and to attain a more holistic understanding of ecological biodiversity patterns and trends.

Relaxation of management practices promotes butterfly communities in mountain grasslands

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European semi-natural mountain grasslands are currently threatened by both land abandonment and management intensification, which calls for more research in theses biodiversity hotspots. In this study we investigated the effects of management practices relaxation on plant and butterfly communities. Thirteen study sites were selected in the southwestern Swiss Alps. Each site included three meadows that have been intensively managed for at least the last 20 years. Adopting a randomised block design, two out of three meadows per study site are now being restored by shifting their mode of exploitation towards low-intensive (1/3 of the fertiliser dose applied beforehand) or extensive management (cessation of fertilisation). Four years after the onset of the experiment, plant species richness increased by 9.3% in extensive meadows. Moreover, butterfly abundance was more than two times higher, and species richness increased by 81% in extensive meadows compared to the control (intensive meadows). The increase in butterfly abundance and richness was mostly driven by a strong decrease in vegetation density and increase in forb cover. Moreover, extensive meadows had higher conservation value, harbouring more threatened butterfly species. No improvement was, yet, detected in low-intensive meadows. Altogether results indicate that the butterfly community can respond rapidly (faster that plant species richness per se) to management changes, following passive restoration.

Mechanisms for maintaining diversity of threatened plant species in burned grasslands: focusing on soil properties and vegetation height

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Semi-natural grasslands have traditionally been maintained under human management. As grazing and mowing are labor-intensive practices, grassland management has been increasingly abandoned recently, while prescribed burning has emerged as an effective and efficient method for maintaining larger grassland areas with less effort compared to grazing and mowing. However, semi-natural grasslands managed only by prescribed burning (burned grasslands) tend to have taller vegetation height compared to when combined with other management practices, which leads to lower diversity of low-growing native plant species, especially threatened species. With the increase of burned grasslands, clarifying how high diversity can be maintained in burned grasslands is an urgent issue for conserving grassland plants. Natural grasslands with low vegetation height can be found under unique soil conditions, such as rocky areas with little soil formation. We hypothesized that a high diversity of grassland plants, including threatened species, is maintained in environments with shallow soil and low vegetation height even in burned grasslands. We compared soil environments and plant diversity among burned grasslands underlain by different parent materials, focusing on soil development variations. We conducted vegetation and soil environment surveys in burned grasslands established on several types of parent material. We aimed to test the hypothesis that plant species diversity would be highest in burned grasslands with less developed soils. In the survey, we established 50 1m2 plots in the lava/scoria grasslands of Nashigahara and 40 plots each in Oishi-highland and Kaida-highland. Vegetation surveys were conducted in June and September and soil water content, hardness and depth and rock and stone cover were measured in September. Soil pH and total extractable nitrogen (N) and plant-available phosphorus (P) contents were only measured in Nashigahara. As a result, the youngest lava grasslands in Nashigahara had the shallowest soils, lowest vegetation height and highest plant diversity including threatened species. In Nashigahara, the youngest lava grasslands had the lowest soil pH, but no significant differences in N and P were found between lava and scoria grasslands.

Bison, cattle, and horse differ in diet, indicating their complementary roles in sustaining species-rich and heterogeneous grasslands

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Large herbivores (≥45 kg) play a crucial role in sustaining biodiverse and heterogeneous grasslands. They shape plant diversity and vegetation structure through consumption of plant biomass. Thus, differences in diet between large-herbivore species are crucial to understand their impact on vegetation and plant species richness. We investigated proportions of plant growth forms and richness of plant genera in the diet of semi-wild populations of horse (Equus ferus caballus), cattle (Bos taurus taurus), and bison (Bison bonasus). First, eDNA was extracted from 350 dung samples collected in 11 rewilding sites located in Central Europe. Next, a list of plant genera present in each sample was obtained by sequencing the ITS marker and matching the sequences to corresponding taxa. To evaluate differences in the relative proportions of plant growth forms and the number of plant genera in the diet of large-herbivore species (cattle/bison/horse) linear mixed effect models including site as random intercept were fitted. Cattle, horse, and bison differed in their diet. Horses were consuming more grasses ($p < 0.001$) compared to cattle and bison. Horses also had the highest proportion of forbs in their diet ($p < 0.001$), followed by cattle, and bison ($p < 0.001$). Bison had the highest proportion of shrubs in their diet ($p < 0.001$), followed by cattle, and horse ($p < 0.001$). Horse diet was marginally poorer in genera ($p = 0.091$; avg. = 24) than that of cattle (avg. = 26), and bison (avg. = 31). These results indicate that all three studied large-herbivore species play an important role in sustaining species-rich and heterogenous grasslands, complementing and potentially facilitating each other in their impact on vegetation. In line with previous studies horses appear crucial for suppression of expansive grass species, while bison should counter shrub dominance the most.

Management intensity effects on plant species richness in semi-natural grasslands in Switzerland

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Semi natural grasslands are an important vegetation type not just for their agricultural productivity, but also the extent of area they cover, ecosystem services they provide, and diversity of species they host. They differ from many habitat types because their existence and persistence require human management. Specific management events and their timing may support biodiversity, but management can also be detrimental, especially if the management intensity expands beyond the sustainable boundary of the ecosystem. We examine how management types and intensity influences plant biodiversity in semi-natural grasslands. Switzerland presents a good opportunity to evaluate the role of different types and intensity of management on biodiversity because of the recent production of a country wide grassland management intensity assessment and thorough mapping of grassland plant diversity. Switzerland also has high climatic, topographical and cultural heterogeneity, resulting in a range of different grassland types and management regimes in a relatively small area. We examine the drivers of grassland diversity in Switzerland using an existing management intensity map, soil and climate data, remote sensing-derived landscape, vegetation, and topography-derived indices, and existing vegetation compositional data from grasslands across Switzerland. We model vascular plant richness using these variables and quantify the importance of management intensity as a driver. This type of detailed understanding of the effect of management intensity on grassland species diversity will be useful to help inform policy.

Trait Plasticity vs. Species Turnover: Grazing Effects on Temperate Grasses in the Scottish Uplands

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In Europe, low-intensity livestock grazing regimes are increasingly used as a tool by managers for maintaining natural and semi-natural grasslands. These regimes help to maintain an open ground canopy and potentially conserve rarer species while increasing the wider biodiversity. It is widely demonstrated that the grazer type and grazing intensity affect the overall structure of grasslands, influencing the distribution of functional traits, however the extent to which these effects relate to species turnover versus intraspecific phenotypic shifts is less understood. For example, more intense grazing typically lowers inflorescence height. How much of this is due to an influx of lower flowering species or a reduction of mean flowering height within the population? An improved understanding of the interplay between these processes under varying grazing regimes would help managers achieve their conservation aims. Here, we investigated the impacts of grazing on the composition and structure of grasses within a long-term (20 years) grazing experiment in the Scottish Uplands. We collected data on grass composition and seven individual-level grass functional traits from 18 plots with three grazing treatments. Multivariate abundance models were used to determine the effect of grazing treatment, plot drainage, and location on grass community composition. Variation between plots was largely due to differences in the relative abundance of widespread species and was driven by plot location, although treatment had marginally significant effects. We then decomposed grass community trait variability to examine the relative roles of species turnover and intraspecific trait variability (ITV) in trait responses to environmental variables and grazing intensities. Our results indicate that ITV is the primary driver of variation across these traits, more than species turnover. Overall, we found that grazing intensity does influence these grass communities but structural changes are largely the results of existing species adapting their trait values to changing levels of grazing rather than community shifts towards species better adapted to that grazing level. This has implications for land managers who can diversify grazing levels in different areas to enhance landscape heterogeneity and biodiversity.

The syntaxonomical position of Brometalia rubenti-tectorum Mediterranean ruderal grasslands

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Mediterranean ruderal dry grasslands of the order Brometalia rubenti-tectorum are characterized by the dominance of medium to tall Mediterranean annuals, in particular grasses. They occur in anthropogenous environments in particular on abndonend fields but alto in clearings in the scrub or on sand dunes in natural situations. They are currentli classified in the class Stellarietea mediae (= Chenopodietea), a classa that includes the ruderal nitrophile vegetation. However, the position of this order in the claass Stellarietea is problematix. In fact Brometalia occur in much more natural conditions than other communities of Stellarietea and they are apparently much less nitrophile. They present instead a strong similarity with the infestant vegetation of wheat crops, which shares with Brometalia rubenti-tectorum a dry, non very nitrophile ecology. Infestant of crops are sometimes included in Stellarietea mediae and sometimes are considered a distinct class in it own. Papaveretea rhoadis . We propose to confimr the distinctiveness of Stipo.Trachynietea distachyae and include in it the two orders Papaveretalia rhoeadis and Brometalia rubenti-toctorum. A thorough study of this vegetation will require to move beyond Europe and collect relevés in the understudied regions of Middle East where this vegetation has its centre of distribution.

Effectiveness of four different seed trap-types in a pampa grassland

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Seed rain is an important element of vegetation dynamics, but still a topic which is not fully understood. Especially in restoration ecology the knowledge about seed rain plays a crucial role to assess the potential contribution of natural grassland to the restoration process. For measuring the natural seed rain, various methods have been used, but there is no standard. The aim of this study was to test four different types of seed traps (Funnel, Pot, Glue and Sticky, the first two 2 cm, the others 50 cm above the ground surface) under two different management regimes (grazed and ungrazed) in a semi-natural pampa grassland in Bahía Blanca (Argentina). The study was set up as a split-plot design with 6 blocks, with the management regime being the main plot and the seed trap type being the sub-plot. We investigated the following dependent variables: (1) contamination with non-seed, trapped material (insects, plant parts and soil), (2) effectiveness in catching seeds (seed density and species number), (3) effectiveness of representing as far as possible the whole plant community (Bray-Curtis Index, Jaccard Index, Pearson correlation and Mantel test). We found the highest contamination with insects for the Sticky traps, with plant parts for the Funnel traps and with soil for the ground-installed traps Funnel and Pot. We found the Funnel and Pot traps to be the most effective traps concerning seed density and the Pot traps concerning species number, respectively. Similar results were also found for the community. According to all measures (Bray-Curtis, Jaccard Index, Pearson correlation), the highest similarity between plant community and the trapped seeds was found for the ground-installed traps Funnel and Pot. Nevertheless, the Mantel test indicated only for the Pot traps a significant representation of the community. Our results underline the importance of seed traps selection for a better depiction of the studied community, an information that is not yet considered in most of the studies. Therefore, more studies are needed to increase the knowledge about the dispersal of seeds to understand the potential role of regeneration from surrounding areas.

Plants, cryptogams and insects reveal the effectiveness of the LIFE DRYLANDS project in restoring lowland acidic dry grasslands

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The "LIFE18 NAT/IT/000803 DRYLANDS" project aims at restoring continental acidic dry grasslands in eight Natura 2000 sites in the western Po Plain. A dynamic approach was applied to restore the structure of the target habitats, aimed to preserve a mosaic of pioneer, intermediate and mature stands. This takes into account the processes driving their formation and results in a higher biodiversity. The main concrete actions carried out included: sod cutting and topsoil inversion, mowing of herbs with subsequent removal, cutting of native and invasive woody species, and planting of typical herb species. The effectiveness of the actions was assessed by the monitoring of (1) vegetation structure as well as the diversity of (2) vascular plants, (3) bryophytes, (4) lichens, (5) carabid beetles, and (6) butterflies. This was performed within circular plots (3 m radius) established within the target habitat patches with an area-dependent sampling effort, in Spring 2020-2021 for the ex-ante and in Spring 2023 for the ex-post. Overall, 64 plots were monitored. Our results showed a clear improvement of habitat structure in the target grasslands, which recovered their open structure. After removal of woody plants and interventions on soil, the cover of therophytes and bryophytes increased significantly, whereas lichens did not show such short-term dynamics. The number of typical species for plants and the overall number of species for bryophytes also increased. Locally, also non-native annual plants were favoured, but they maintained low cover values. The overall species richness of carabid beetles and butterflies remained about the same, but the number of sampled individuals more than doubled, and the number of species sampled per patch also increased; especially carabids also showed an increase in species typical of open habitats. The results confirmed the appropriateness of a multitaxon approach to evaluate the effectiveness of grasslands restoration, with the different taxa providing different perspectives on its effects. The monitoring should continue also in future years, to better elucidate the effectiveness of the method on the long term and any critical issues linked to the different responses across different taxa.

The role of high nature value grasslands for insect conservation in an Alpine region

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In Europe, agricultural intensification and land-use change are causing a widespread decline in insect diversity, which requires an impact assessment of land-use practices. Furthermore, climate change is expected to pose an additional threat in altering the climatic niches, community compositions and trophic interactions. Butterflies and orthopterans are considered important ecological indicators, especially in grasslands, where human intervention is the main cause of both their demise and conservation. In this study, – conducted within the framework of the Biodiversity Monitoring South Tyrol – 214 butterfly and orthopteran communities were compared across seven dominant land-use types in the mountainous region of South Tyrol, Italy. These land-use types, which extend from lowlands to alpine grasslands (214-2455 m a.s.l.), include meadows and pastures of varying land-use intensity as well as vineyards, arable land, apple orchards and settlements. For both butterflies and orthopterans, we found that high nature value (HNV) grasslands support high species diversity, with species numbers ranging from double to one-third more than in non-subsidized sites. Furthermore, these grasslands host more specialised and threatened communities than all other land-use types. Community compositions varied across land-use types and were influenced by plant-based indicator values reflecting site management. The climatic environment exerted a significant influence on community composition, yet its overall impact on biodiversity scores (especially for butterflies) was less pronounced than that of land use type and intensity. These findings reinforce the efficacy of regional agri-environmental measures and the European conservation strategy, which aims to preserve HNV grasslands.

From an intensively used meadow to a biodiversity hotspot: The projekt “colourful grassland” restores grassland in the Allgäu since 2018

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Central European grasslands are inherently important for the protection of natural resources, climate, and biodiversity. However, especially colline grasslands show extreme losses in biodiversity due to intensification. The landscape in the grassland region of Allgäu (Southern Germany) is dominated by species-poor intensively managed meadows. Farmers are usually well trained and skilled in grassland intensification. Conversely, techniques for restoring species-rich grassland are mainly unknown. Reasons for restoration efforts can be intrinsic motivation or obligations set out by authorities (restoration of lost biotope grassland or FFH meadows (habitat types 6510/20)). The main aim of the project is to develop and disseminate recommendations for restoration actions on farms. The study site is a 3.2 ha meadow near Leutkirch im Allgäu, which was previously managed intensively (6 cuts + fertilizer applications per year for silage production over many years). It was converted into a species-rich meadow by direct wild plant seeding and transfer of species-rich plant material. Methodically, the field was divided into 12 plots of equal size, which include different mowing regimes (two and three cuts), six different cultivation (tilling and harrowing) - and sowing ratios. In addition to the annually recorded hay yields, a monitoring of vegetation and two grassland-typical insect groups evaluates the ecological development of the plots every two years. Extensivation measures resulted in different developments over the years with overall positive results. Restoring the phytocoenosis, typical for the region, takes multiple years and is therefore still ongoing. The biodiversity of typical meadow insects continues to show a substantial positive trend. Despite strong fluctuations in weather conditions (dry summers 2018, 2019 & 2022), yields only fluctuate by -15 to +10 % around annual means. Recommendations for restorations action for species-rich meadows are derived from the results of this long-term study.

Wet meadows in the Wienerwald biosphere reserve - Severe habitat deterioration of Natura2000 habitats despite Agri-environmental measures

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Wet grasslands are facing severe threats due to agriculture intensification and climate change related decreasing soil water contents. The UNESCO biosphere reserve concept seems to provide fitting solutions to secure the diversity of grasslands, aiming on connecting nature conservation and sustainable economic development. A further strategy is the implementation of agri-environmental schemes (AES) to promote sustainable land use. This study analysed the development of 92 sites belonging to the EU habitat types 6510 (Lowland hay meadows), 6410 (Molinia meadows) and 7230 (Alkaline fens) ten years after a first survey. To detect changes in habitat development we assessed the EU conservation status on site level and compared the results with the prior study. We further conducted vegetation surveys to get more detailed information on diversity measures and species composition. To test for effects of AES measures on the given variables we compared habitat development and plant diversity between sites with different agricultural management. On average, conservation status of the monitored grasslands declined by one rank within the last 10 years in the biosphere reserve. AES management weakened this deterioration although trends were still negative. Furthermore, no influence of AES management on plant diversity or number of threatened species per plot could be found. Conservation status development was worst on Alkaline fens which rely on the wettest and nutrient poorest soil conditions. Differences in habitat type development could be associated to nutrient and water demand of the different plant communities. Alkaline fens showed decreased moisture values on sites where a change in habitat type occurred, indicating negative effects of decreasing soil water contents. Molinia meadows showed higher nutrient levels on sites with a bad conservation status, indicating negative effects of increased nutrient contents. We conclude that AES measures in the current extent are not sufficient to halt habitat deterioration of wet grasslands. Especially Alkaline fens are under acute threat in the biosphere reserve and seem not to be addressed by AES management. To stop negative development additional measures such as an active involvement of farmers and habitat specific management are needed.

Evaluation of soil seed bank restoration potential in rangelands of the Kyzylkum desert along degradation gradients

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In Uzbekistan, where rangelands make up around 57% of the nation's total area or over 21 million hectares, grazing is a significant land use. Arid and semi-arid plains are associated with around 78% of those rangelands. For many years, indigenous animal husbandry has used these regions. Year-round unsustainable grazing close to populated areas has resulted in overgrazing and trampling, which has degraded rangelands and reduced biodiversity. Considering the importance of the soil seed banks (SSBs) in the self-restoration of those degraded rangeland ecosystems, assessing the restoration potential of the soil seed bank is crucial. Until now, research on SSBs has not been conducted yet in Uzbekistan. Our study aims to assess the regeneration potential of the rangelands by evaluating SSB density and species composition and comparing it with existing vegetation in Southern Kyzylkum desert rangelands to learn the importance of the seed bank resources in the soil and their interaction with aboveground vegetation. We evaluate the vegetation and the seed bank along a grazing intensity gradient starting from the severely overgrazed areas near watering wells towards the moderately grazed distant areas. There were 20 study sites which were distinguished into two categories: abandoned and functioning watering wells (WWs). We chose four different gradient zones in each site by moving away from the WWs to assess the SSBs and existing vegetation: WW – at the sacrificed zone at the watering point; WW + 500 m; WW + 1000 m; WW + 2000 m. Each zone included two transects and three plots (5x5 m) were in a transect (in total 480 plots). Three soil samples (in total 1 500 kg soil) were taken from each plot and existing dung numbers were counted in every corner of the plot. The soil samples have been concentrated by 0.25 mm sieves and their germination will be started in August 2024 for SSB analysis. The preliminary results of the vegetation survey showed that Peganum harmala was a dominant species of the sacrificed zone of all sites, which indicates the degraded rangelands. With increasing distance from the WW, the vegetation communities became increasingly species-rich, with species Artemisia diffusa, Carex physoides, C. pachystylis in the best quality rangelands grazed by low intensity.

Investigating pollinator communities and pollination networks throughout the summer season in Central Italy

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The study was conducted as a parallel activity to the LIFE BeeAdapt project, which aims to improve the territory's resilience to climate change by designing pollinator-oriented Green Infrastructures. The final goal of the project is to buffer the effects of climate changes on pollinator communities. The present study provides an essential knowledge baseline that is crucial for the development of such infrastructures and future studies. The study investigates the current structure of pollinator communities and their interactions with local vegetation by analyzing the shifting of pollinator species composition throughout the summer season and the pollination networks that are present in the area. Desynchronizations between pollinators and flowering times may indeed affect pollinator communities therefore, a deep understanding of the current state of the environment is crucial. Pollination networks are complex interactions shaped by the dependencies between plants and their pollinators. Through network analysis, it is possible to illustrate the complex relationships between pollinators and plant species, which are essential for understanding the stability and resilience of ecosystems affected by environmental changes. Data were collected in 2 study areas at different altitudes within the Torricchio Mountain Nature Reserve in Central Italy. The 2 areas were then divided into experimental and control areas. In each of the 4 sub-areas, a 500m transect was established. Data on the abundance of pollinators (Hymenoptera and Lepidoptera) and their interactions with vegetation were collected by 2 expert observers following the protocols of the LIFE BeeAdapt project. A shift in both pollinator and vegetation communities is visible with the progression of the summer season and, by analysing the pollination networks, preferential interactions between pollinators and floral species were detected, providing insights into pivotal species essential for maintaining ecosystem resilience.

Effect of season, stakeholder group and meadow type on the visual appreciation of grassland in the Trudner Horn Nature Park

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Nutrient-poor meadows (NPM) are a characteristic element of the Trudner Horn Nature Park (South Tyrol, Italy). In general, they are not fertilised and are mown only once a year. The aim of our study was to investigate the visual perception of these meadows by different population groups visually in comparison to other, more intensively managed meadows (IMG). To this end, an online questionnaire was used to survey grassland farmers, apple and wine growers and the general public not working in the agricultural sector. Respondents were asked to rate the aesthetic value of landscape images of NPM and of more intensively managed meadows at three different phenological vegetation stages: at the begin of the growing season (SGS), during the growing season before the flowering stage was attained (GBF) and at flowering (FLO). The highest appreciation was expressed for grassland at the FLO stage. As expected, the lowest values were given for grassland at the SGS stage, whilst the scores of GBF were intermediate. At the FLO vegetation stage, higher scores for NPM than for IMG were provided by all groups, but grassland farmers rated IMG lower than the other groups. They also rated IMG higher than the other groups in the SGS stage, suggesting that they have a higher aesthetic appreciation for grassland when flowers are absent and grassland biomass is low.

The role of invertebrates and microbes in shaping alpine grasslands soil respiration

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Belowground production of CO2 has been suggested to be highly responsive to climate change, but there are large uncertainties as to the role of soil organisms involved in the mineralization of soil organic matter and subsequent CO2 release. Combining field observations across montane and subalpine grasslands in the Central Alps with manipulative incubation experiments, we investigated the role of microbial and invertebrate community compositions and activities in shaping soil respiration under different environmental conditions and weather extremes. We measured soil CO2 release jointly with the soil functional profile based on targeted microorganisms' intracellular DNA fractions, which contained information about the active organisms in soil and we classically determined the prevailing soil fauna and biomass. First results indicate distinct effects of soil invertebrates on microbial communities with cascading consequences for soil CO2 emissions, which were particularly pronounced under weather extremes.

Moderate grazing sustains flower traits' diversity in semi-natural grasslands

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Semi-natural grasslands are crucial for the diversity of flowering plants and insect pollinators, which is facing a dramatic decline globally. The diverse range of floral traits in semi-natural grasslands typically supports various pollinator species through niche partitioning, enhancing pollination services across agricultural landscapes. However, this support is threatened by shifts in farming intensity. We aim to link grazing regimes to the floral traits in a semi-natural grassland habitat of conservation concern in the European Union. We sampled plant species composition in 116 plots of 16m2 within extensive farms and ungrazed areas across a wide latitudinal and altitudinal range encompassing Italy and Switzerland. We measured seven flower traits relevant to plant-insect interactions and calculated functional diversity (FD) and community-weighted mean (CWM) for each trait. We compared grazed and ungrazed flowering communities using non-parametric tests; and in grazed areas we fitted piecewise structural equation models to investigate the direct and indirect, i.e., through species diversity, effects of grazing regimes on FD and CWM. FD did not differ between grazed and ungrazed grasslands, except for phenology, with grazing enhancing the variation in flowering initiation and duration. Grazing also favoured species with pink, small flowers with low UV-reflectance, early onset and short flowering duration. Within grazed areas, moderate grazing intensity increased FD of morphological, phenological traits and floral reflectance by enhancing species diversity. Sheep grazing favoured FD of flower morphological traits. In moderately grazed grasslands, bilateral and non-yellow flowers were more abundant. Based on our results, grazed grasslands may sustain insect pollinators, especially in seasons other than spring and summer. Promoting moderate grazing and favouring sheep over cattle or horses may support the diversity of pollinator species either directly or indirectly through the enhancement of species diversity.

Hotspots of (sub)alpine plants in the Irano-Anatolian Global biodiversity hotspot are insufficiently protected

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Aim: The mountainous regions in SW Asia harbours a high number of endemic species, many of which are restricted to the high elevation zone. The (sub)alpine habitats of the region are under particular threat due to global change, but their biodiversity hotspots and conservation status have not been investigated so far. Location: Subalpine-alpine habitats of SW Asia Methods: Distribution data of all (sub)alpine vascular plant species of the region was compiled, resulting in 19,680 localities from 1672 (sub)alpine species, the majority of them being restricted to the region (76%). Six quantitative indices of species diversity were used on the basis of 0.5°×0.5° grid cells to identify (sub)alpine hotspots. Hotspots whose surface area in the (sub)alpine zone was covered by nature reserves maximally by 10% were defined as conservation gaps. Results: A high proportion (80%) of the endemic species of the study area is range-restricted and narrowly distributed. The results of all six indices were highly correlated. Using the top 5%, 10% and 20% richest cells supported by any index, 32, 53 and 98 cells, respectively, were identified as Hotspots. Almost 60% of these Hotspots at all three levels were identified as unprotected (i.e., constituted Conservation Gaps). Generally, only 22%, 18% and 16%, respectively, of the alpine surface area of the identified Hotspots were covered by nature reserves for the top 5%, 10% and 20% richest cells, respectively. Main conclusions: Although the rate of protection in (sub)alpine Hotspots exceeds that of the entire region it is still insufficient, because these Hotspots are much richer in endemic and in range-restricted species, but at the same time are under high pressure of global change. Therefore, the establishment of new nature reserves with high conservation efficiency in (sub)alpine habitats with a particular focus on the identified Hotspots is strongly recommended.

Evaluating the impact of grassland management on wild bee communities along an elevational gradient

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Extensively managed grasslands are crucial ecosystems for wild bees, providing essential resources such as pollen, nectar, and nesting sites. However, these ecosystems face significant threats from land-use intensification, abandonment, and climate change. In mountain regions, grasslands span from low to high elevations and are therefore characterized by strong changes in abiotic conditions. Due to these variations, the effects of land-use intensity observed in lowland studies cannot be directly extrapolated to higher elevations. In this study, we investigate the potential synergistic and additive effects of land-use intensity along an elevational gradient. We assume that reduced land-use intensity promotes a more diverse wild bee community composition even at higher elevation, where abiotic conditions are a limiting factor. Understanding these effects is critical for developing targeted conservation strategies, particularly for climate change adaptation. We assessed wild bee communities across 30 grasslands characterized by a varying degree of land-use intensity and elevation (700 – 2100 m a.s.l.) using time- and area-standardized transect walks, along with yellow, white, and blue pan traps. Surveys were conducted over two sampling seasons from May to August. During the first season, we recorded a total of 1,216 wild bees representing over 130 species. Preliminary analyses indicate that the effect of increasing elevation on wild bee abundance is more pronounced when flower richness decreases. Wild bee species richness also decreases with declining flower richness, suggesting a positive effect of extensive grassland management practices on wild bees along elevational gradients. Additional analyses focusing on functional diversity, community composition and plant-bee interactions will offer a more comprehensive understanding of how wild bee communities respond and adapt to varying land-use intensities and changing climatic conditions.

Extensive management practices and natural structural elements enhance bat conservation in mountain agricultural landscapes

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Changes in agricultural practices have been recognized as a significant driver of biodiversity loss worldwide. Bats are facing a global decline primarily due to habitat loss and agricultural intensification. In Italy, the International Union for the Conservation of Nature reports that 33% of bat species are threatened by agriculture expansion. This study investigates the impact of natural structural elements and agricultural intensity variables on bat diversity. We selected 47 sites in open agricultural areas, considering pastures, hay meadows, dry grasslands, and annual crops. The total area of natural structural elements (e.g., hedgerows, trees), a management intensity index, the presence of manure hills, a grazing pressure index, and the frequency of cutting events in hay meadows were selected as the most important variables to explain agricultural intensification in mountain environments (South Tyrol, Northern Italy). We used generalized linear mixed models to analyze the acoustic activity of bats divided into guilds in relation to agriculture-related variables and landscape features such as distance to water sources, buildings, roads, and forest types. Overall, the results revealed that natural structural elements and wetlands, positively influence the presence of short-range echolocators and low foragers, playing a key role for bats in agricultural areas. Grazing and mowing practices showed mixed impacts on bat diversity, while the presence of manure hills displays a negative correlation with most bat species. This study underscores the need for nuanced approaches to agricultural management that consider the complex effects on bat species diversity. It highlights the importance of maintaining natural structural elements and implementing extensive grazing and mowing practices. The findings contribute to a holistic understanding of how agricultural practices and natural structural elements can support or compromise bat populations and overall biodiversity in agricultural landscapes, facilitating targeted conservation actions in the context of the EU Biodiversity Strategy.

Acoustic monitoring and automated identification of grassland bird communities in an Alpine environment

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Grassland birds are particularly sensitive to land-use change and intensification, which has led to declines in many species. Passive acoustic monitoring and automated identification are increasingly used to assess avian diversity. Open grasslands are particularly suitable for this method due to the lack of acoustic barriers and low background noise for the microphones. In spring 2024 we carried out a passive acoustic bird monitoring within the framework of the Biodiversity Monitoring South Tyrol, a long-term monitoring in a mountainous region. We selected 28 grassland sites that were divided into meadows and pastures, colline-montane and subalpine-alpine zones (based on the elevation) and their management intensity. At each site we placed a recording device (AudioMoth v.1.2.0) to record bird songs throughout the whole breeding season. To analyze the collected data, we used the bird song recognition software BirdNet Analyzer 2.4 and Raven Pro 1.6.5 for the analysis and batch processing. We focused on species richness and analyzed the grassland soundscape by using various acoustic indices. BirdNet identified most bird species correctly, but human verification is still needed. In particular, identifications with a low confidence score, a value given by BirdNet that describes the probability of correct detection, are prone to error. By building species-specific confidence thresholds, the performance of BirdNet can be significantly improved. A diverse soundscape is highly correlated with a diverse landscape and a richer bird community.

Beta diversity at boundaries higher than in patch interiors

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With varying environmental conditions at the edges of habitat patches, due to and in concert with edge effects, the community composition should differ as well. This should lead to a peak in small-scale beta diversity across boundaries between habitat patches. So far there is, however, not much research on this fundamental pattern conducted and no unifying model has been formulated. Here, we present such a conceptual model on beta diversity across boundaries, derive patterns of underlying environmental parameters and responding functional traits, and test this framework on plant diversity at crop field – dry grassland boundaries in two German landscapes. We surveyed the vegetation and sampled soil parameters along twenty transects, extending approximately 30 m into both habitats. Ecological indicator values and species functional traits were also assessed. Across the boundary, we found a peak for plant beta diversity (for the turnover component, not nestedness) and a steeper gradient than in adjacent habitat interiors for most tested environmental parameters, indicator values and plant species traits. This confirms our theoretical framework. In our study, the peak of beta diversity was due to a replacement of species (turnover), not to additional (or missing) species without replacement (nestedness). In the landscape, visible boundaries are reflecting the underlying abiotic conditions, and are reflected by the deriving species functional traits. We provide a unifying model for the small-scale pattern of beta diversity across boundaries between different habitat types here. As the peaking beta diversity at boundaries increases the species diversity at the landscape level, landscape heterogeneity should be promoted for biodiversity conservation.

Vegetation of species-rich grasslands of the forest-steppe and Submediterranean areas of Europe and its determinants (PhD project)

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Forest-steppe grasslands are on a fine scale extremely species-rich ecosystems where we can find even more than 100 species in an area of 10 m2. Their species composition is unique, nonetheless, it is repetitive in isolated localities of occurrence. The most species-rich and precious segments of forest-steppe grasslands belong to Brachypodio pinnati-Molinietum arundinacae association. It is a community described in White Carpathians, the western edge of the forest-steppe zone that continues further through central-eastern Europe, Romania, up to western Ukraine. This association is characterized by a mixture of species with different ecological needs – their cooccurrence is thus rare and determined by specific conditions such as landscape heterogeneity, land use, geographical position, bedrock, etc. This community used to be considered unique to the area of White Carpathians. However, recent studies support its distribution on the periphery of the entire Western and Eastern Carpathians, and in some adjacent regions. It is interpreted as a relic of late-glacial and early-Holocene ecosystems that persisted in mesic habitats due to continuous disturbances such as grazing by large herbivores, fire, and later on, it also became maintained by activities connected with human settlement. Besides the studies from the Carpathians' region, there are also numerous data in the literature confirming the appearance of similar vegetation in south-eastern and southern Europe, that has been very sparsely researched so far. This project aims to investigate the connection between the Pericarpathians' forest-steppe grasslands and analogical vegetation types in the Submediterranean areas. We focus on their composition with many shared species, and on the ecological factors crucial for the development of such habitats. This part of the project is based on vegetation sampling including recording of environmental factors such as bedrock type, pH, relief and climate data, management type, etc. Next, we intend to model the past, potential, and future distribution, and species richness of these grasslands. We will combine the environmental and historical data and use them to search for areas from where such species-rich meadows are not known yet.

Grasslands4Biodiversity (G4B) – Supporting the protection of biodiversity-rich grasslands through management practices in the Central Alps

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Semi-natural grasslands are among the most species-rich habitats in Europe, but they have declined sharply in recent decades. G4B assesses the natural conditions and management activities that influence grassland plant diversity in the Alps and Carpathians. To achieve these objectives, we collected more than five thousand spatially explicit botanical records, mainly using the Braun-Blanquet method, from Tyrol, South Tyrol, and adjacent regions. These data are then linked to topographic, climate and land-use information provided by farmers and stakeholders through questionnaires and interviews to identify biodiversity-supporting grassland management regimes. A first evaluation shows how strongly management influences the number of plant species. Non-fertilised hay meadows have an average of forty species. A similar number of species can be found in agroforestry systems and low-stocked pastures. The number of species decreases significantly with increasing frequency of mowing and fertilisation to an average of fifteen species. The spatial distribution of plant diversity and connected management practices provides stakeholders with sound knowledge to design and implement grassland management schemes that boost biodiversity.

Challenges and Solutions in the Restoration of Dry Continental Grasslands in Brandenburg / Germany

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The habitat types 6120* (Xeric sand calcareous grasslands) and 6240* (Sub-Pannonic steppic grasslands) in Brandenburg face numerous challenges. We will share the key challenges in restoring these valuable ecosystems and discuss potential solutions. A particular focus is placed on the efforts of the Stiftung NaturSchutzFonds Brandenburg within the framework of two LIFE projects. The loss of traditional land use practices, such as extensive grazing and mowing, significantly contributes to the decline of these habitat types. These practices are essential for maintaining biodiversity but are often economically unattractive and therefore declining. Another central issue is the lack of long-term financial security for the long-term management of grassland habitats. Sustainable financing is crucial but often difficult to secure, complicating the long-term maintenance and monitoring of the areas. A major threat are invasive species, which displace native flora and reduce biodiversity, requiring extensive and costly control measures. Climate change exacerbates this issue through extreme weather events such as droughts, which jeopardize the stability of restored areas. Land-use intensification near protected areas, such as industrial agriculture, leads to nutrient inputs and pesticide contamination, significantly hindering restoration efforts. This complicates the re-establishment of sensitive dry grassland plants that prefer nutrient-poor conditions. Legal conflicts, particularly the regulations of the Forest Act and the Soil Protection Act, can hinder the management of existing habitats and the creation of new habitats. The grazing of forest areas may be restricted by regulations as well as the recreation of bare soil areas. Nevertheless, these measures are crucial to maintain and redevelop suitable site conditions for dry grassland species. In two LIFE projects, the Stiftung NaturSchutzFonds Brandenburg has gained a wealth of experience in dealing with these challenges. In the presentation, we would like to show how we deal with these difficulties and have contributed significantly to the conservation and restoration of habitat types 6120* and 6240* in Brandenburg / Germany.

The interplay between management and environmental conditions influences Alpine grasslands' ecosystem services (Eastern Alps, Italy)

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Extensively managed grasslands are recognized globally for their high biodiversity and deliver multiple ecosystem services (ESs). Understanding how the relations between ecological factors and management practices condition the delivery of ESs allows for optimizing the spatial arrangement of grassland management practices within a multifunctional pastoral system. The research questions were: i) How do environmental conditions constrain ESs? ii) What is the effect on ESs of the interaction between current management and environmental conditions? iii) How does the interplay between current management and environmental conditions impact ESs in different management units? We used Redundancy analysis to analyse the variation of forage quantity (community's plant height) and quality (pastoral value, specific leaf area), the abundance of insect-pollinated species, abundance and diversity of eye-catching flowering species, species diversity, richness in protected species and species of conservation, alimentary, and pharmaceutical interest in 12 malghe (summer pastures) and five meadows in the Eastern Alps (Parco di Paneveggio-Pale S. Martino, Trentino-Alto Adige, Italy). We related them to environmental and management variables. Our results showed that: (1) environmental conditions played an important role in enhancing provisioning ESs (South-facing slopes were the most productive and with higher-quality fodder); (2) there were synergies between forage provision and taxonomic diversity and between entomophilous pollination and touristic attractiveness; (3) there were trade-offs between forage provision/diversity and entomophilous pollination/touristic attractiveness, as well as between protected species and the other ESs. These trade-offs underlay differences partly in management (mowing vs grazing) and partly in environmental conditions (conservative landforms with more acid soil pH vs. non-acid soil pH, valley bottoms, and steeper slopes). This observation implies that to restore ESs in overgrazed and abandoned grasslands, it is necessary to plan different management strategies in the different management units, based on the spatial arrangement of the most suitable conditions to foster more ESs simultaneously.

Impact of climate change on flooding of Palaearctic grasslands

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Flooding causes unfavorable changes in the ecological environment. The quality of soils deteriorates, pastures become swamped, which leads to the death of plants. The factors influencing the process of flooding of pastures and Palaearctic Graslands are considered using the example of the territory of Northern Ostrobothnia in Finland. These include: abnormal rainfall, rising levels of the Gulf of Bothnia and seismological activity. Annual sea level rise (SLR) of 3.2 mm. Over the past 25 years, the increase has been 7.5 cm. Vertical land movement (VLM) in the northern Baltic Sea is caused by the slow recovery of the crust under pressure from the ice sheet that covered the area during the last ice age. On the Finnish coast, the rate of land rise is from 3 to 9 mm/year. Abnormal amounts of precipitation are the main cause of flooding of Palaearctic grasslands. Using methods of mathematical statistics, long-term data from weather stations were analyzed. The obtained data were compiled into tables and graphs, which made it possible to identify anomalous indicators of precipitation and temperature and determine their current trends.The water balance of the flooded area of Manquila was calculated. A set of measures to prevent flooding has been proposed, in particular a new patented method for lowering the groundwater level.

Changes in network properties influence pollination services in plant-pollinator communities in an East-Asian mega-city area

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Plant–pollinator interactions in urban semi-natural grasslands are ideal subjects for investigating anthropogenic activities as drivers of ecological network decline in terms of diversity and functionality. Pollinators are vulnerable to anthropogenic disturbance as evidenced by the decreasing richness observed in many urban grasslands globally. Reduced flower and pollinator richness is expected to facilitate network downsizing and generalization, which may diminish pollination functions. To test the hypothesis, we examined the structure of 30 plant–pollinator networks and the pollination success of 12 native plant species in urban–rural paddy grasslands in an East-Asian megacity area. Pollination networks of more urbanized grasslands were significantly smaller and more generalized than those of rural grasslands. Community-wide pollination success was influenced by the degree of surrounding urbanization, network generalization and non-native flowers. The results generally support the hypothesis but suggest some positive effects of generalized urban networks on pollination services for native plants.

The functional roles of insects in grassland ecosystems

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Grassland ecosystems are characterized by high levels of plant and insect diversity. Various insect taxa are recognized as having important roles in a diverse range of ecosystem services, such as pollination, decomposition and nutrient cycling. They are also involved in many trophic interactions with plants, such as predation, parasitism, phytophagy and spermatophagy. The study of functional traits can help us to understand the role of trophic interactions and the relationship between functional diversity and species diversity. In this presentation, I will present a study on the analysis of the functional traits of a broad range of beetle taxa in a set of open and wooded urban habitats in the city of Warsaw, Poland, and discuss the use of functional data to study plant-arthropod interactions in grassland ecosystems. My approach involved the used of fuzzy data to generate a usable set of data on a comprehensive range of traits. I will discuss the implications of these results for such concepts as ecological resilience and redundancy.

Changes in multifaceted biodiversity across spatial scales and grassland types

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Assessing biodiversity requires considering various aspects, including the multiple facets of biodiversity and the spatial scale at which it is measured. Whether different biodiversity facets exhibit the same patterns across spatial scales for various vegetation types remains unclear. We aimed to observe patterns of biodiversity changes across scales and facets in different grassland types. Specifically, we asked: 1) How does biodiversity change in different grassland types across scales from the perspective of different facets of biodiversity? 2) Can hotspots at smaller scales become coldspots at larger scales, and vice versa? 3) Are there situations where a vegetation type is rich in one biodiversity facet but not in others? 4) What causes shifts in biodiversity richness: rare or common species? We used a dataset of nested-plot series of grasslands in Ukraine, with seven grain sizes ranging from 0.001 to 100 m², and assessed metrics of taxonomic, phylogenetic, and functional diversity. By considering species presence/absence and relative cover in the community, we evaluated the influence of common and rare species. Our results showed various shifts in hotspots and coldspots for different facets of biodiversity and grassland types across spatial scales. This was particularly evident for functional diversity, where communities were poor at small scales but rich at larger scales in meso-xeric grasslands and vice versa in steppe depressions. We also observed the significant role of rare species in biodiversity rankings. Incorporating multiple facets of biodiversity and varying spatial scales is important for accurately assessing biodiversity and prioritizing grassland conservation efforts.

Changes in the Orthoptera communities of the Tatra Mountains (Carpathians) from1950s to 2020s

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Orthoptera are a group of insects especially reliant on grasslands and the megafauna. The latter are responsible for i. a. maintaining the open or semi-open character of environments, providing a wide range of habitats for other organisms. Large herbivores have been present across Europe for the last 35 Myr, but have been extirpated at the end of Pleistocene by early humans. Since the Neolithic revolution livestock and other human land-use have restored some of the functions lost with the wild large herbivores. However, livestock grazing has been banned or abandoned across much of Europe during the 20th century, with possibly strong effects on biodiversity. In the Tatra Mountains livestock grazing was banned in 1960s, thus, overgrowing and degradation of grassland habitats may have become a serious threat since then. We surveyed Orthoptera communities of the Tatra National Park in 2022 and 2023, visiting 29 localities and collected 912 species records. We extracted data on historical species abundances. We calculated relative species abundances by dividing the value for each species by summed-up abundance of all species, and computed diversity indices. We found that evenness (Shannon diversity index) decreased in the 2010s (1950: 2.7; 2010s: 2.47) but increased again in 2020s (2.68). In the 1950s the communities were dominated by cold-adapted species with a substantial presence of xeric species (e.g., Myrmeleotettix maculatus). The reduction in evenness in the 1990s was driven by the relative increase in 2 species (Euthystira brachyptera – thermophilus and Roeseliana roeselii – eurytopic). While these species remained dominant in 2020s, one thermophilus (Chrysochraon dispar), and three cold-adapted species (Gomphocerippus rufus, Isophya camptoxypha, and Metrioptera brachyptera) increased in relative abundance. We hypothesize that the strong increase in thermophilus species may have been driven by climate change, while the increase in cold-adapted species and the strong decrease in xeric species (Myrmeleotettix maculatus – 5th most abundant species in 1950s – probably extinct now) may be due to grazing abandonment and the associated densification of the herb-layer.

Hay meadows are crucial habitats to focus conservation efforts in the coming decades: vegetation resampling first results in Trentino, Italy

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The study analyses the conservation status of hay meadows in Trentino, a mountain region in the south-east of the Alps. Here, the valley floor have long been confronted with increasing infrastructural development and pervasive cultivation, especially orchards, which reduce the extensive meadows to rarities. Mountain grasslands, on the other hand, are undergoing a period of strong change. This is partly due to the economic-social pressure towards greater profitability combined with the persistence of traditional practices. Hay meadows of the subalpine horizon are somewhat less undermined, although a component of abandonment and conversion to pasture is known. The altitudinal distribution of pressures presented above, leads to the fact that immediate change is concentrated in mountain areas, where grasslands are still widespread and closely linked to livestock management. Given the uncertain status of open areas conservation, their well-known biological richness and their essential structural function both ecol

Biodiversa+ Habitat Pilot: Finding a shared method for mapping and monitoring grasslands and wetlands using Remote Sensing data

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Biodiversa+ is a multi-national partnership co-developed by the European Commission to support the biodiversity goals and increase harmonization of biodiversity data handling and research methods across Europe. For harmonizing the long-term transnational monitoring of biodiversity, Biodiversa+ has launched a series of pilot studies. Each pilot focuses on distinct aspects of biodiversity monitoring according to monitoring and indicator development priorities of Biodiversa+, and includes several countries collaborating to test and develop methods for monitoring. One of the pilot studies is the Habitat pilot which aims to assess methods for mapping and quality monitoring of grassland and wetland habitats using remote sensing (RS) data. The Biodiversa+ Habitat Pilot includes 11 European countries and regions as active partners. The pilot was planned during 2023, and started in February 2024 and is currently concluding its first project module. The first module consisted of (i) identifying and assessing synergies between the Habitat Pilot and other existent projects (e.g., EU Grassland Watch) and (ii) reviewing the current practices and prior experiences of the partner countries of using both RS-based and more conventional field-based methods for mapping and monitoring natural areas. During the review, the partners gathered information on over 40 different projects and methods for habitat mapping and monitoring, highlighting aspects such as used data sources, spatial coverage, identified strengths and weaknesses, etc., for each project and method. Subsequently, the methods best aligning with the scope of the Habitat Pilot, i.e. to find harmonized methods that could be applied across the whole continent, were discussed more in detail during a workshop hosted by Eurac research in Bolzano in early June 2024. After these discussions, a joint decision was made on which methods should be tested in the pilot partners' field study sites. In the following project modules, over the next year and a half, the pilot partners will test the selected mapping and monitoring methods in their grassland and wetland sites. Finally, a report on the results from the method implementation and on the outcomes of the pilot study itself will be produced.

Benchmarks of species richness in Palaearctic grassland classes

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Palaearctic grasslands are known for the high species richness of vascular plants. So far, most of the records of different plot sizes up to 100 m2 were recorded in meso-xeric grasslands of the class Festuco-Brometea in the Carpathian region of Central Europe. In our study, we aimed to assess alpha diversity patterns among phytosociological classes of grasslands and other open habitats across taxonomic groups, plot sizes and regions of the Palaearctic. We extracted 121,633 vegetation plots of eight “standard” sizes (0.0001, 0.001, … 1,000 m2) with class assignment from the GrassPlot v.2.14 database. We obtained benchmarks of species richness of phytosociological classes for different plot sizes, taxonomic groups (vascular plants, bryophytes, lichens) and regions. For vascular plant species richness at 10 m2, the top ten classes were grasslands of different climate zones, with the Mediterranean therophyte-dominated grasslands on limestone (Stipo-Trachynietea) ranked first for the mean richness values, while temperate dry grassland and steppe vegetation (Festuco-Brometea) had the maximum richness values. The poorest group consisted of scree, coastal dune and saline classes. Mean species richness showed variation among regions, with patterns varying by class. We found new hotspots of maximum and mean species richness and demonstrated that mean species richness is generally higher in Palaearctic non-forest vegetation than previous studies have suggested. Our findings of new regional and syntaxonomic hotspots contribute to ecological theory and may spur the search for new records. Since high-quality data are still missing for many regions and syntaxa, GrassPlot calls for filling these knowledge gaps (https://edgg.org/databases/GrassPlot).

Higher Education on sustainable management of pastoral systems: a key tool for grassland biodiversity conservation

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The conservation of grasslands, one of the most biodiversity-rich ecosystems in Europe, is a major goal of the EU natural conservation policy. It is strictly linked to pastoralism, and the maintenance of economic activities such as dairy and wool production. The strong decline of pastoralism over the last decades, especially affected mountain areas, which experienced widespread depopulation and impoverishment. Such decline was combined with the new challenges linked to the adaptation of animal husbandry to climate change, regarding the maintenance of the quality of products whilst ensuring environmental sustainability. The complexity of grassland management requires a professional figure able to address in a multidisciplinary way the sustainable management of European pastoral systems. The Erasmus+ TranSuMan project "Advanced training on sustainable management of pastoral systems" (2021-1-IT02-KA220-HED-000032227), implemented by the University of Camerino (coordinator), University of Babes-Bolyai, University of Thessaly, and Catholic University of Valencia, aimed to fulfil this need, by fostering collaboration between the academic world and the actors in charge of the management of grasslands. The main project output was the "Modular online course on sustainable grassland management", targeted to HE students, teaching staff, researchers, and stakeholders (farmers, representatives of farmers associations and public bodies, managers, and technicians of protected areas). Thirty-two students from the four partner Universities followed an intensive course on the project topics. The course included frontal lessons and a study visit during which students could participate in practical activities (e.g. assessment of sheep body condition in a farm, involvement in cheese-making in a cheese factory, and execution of a phytosociological relevé) and discuss with local stakeholders about grassland management issues. The modular online course, planned according to methodological guidelines for participatory grassland management implemented at the start of the project, took the form of a Concept Map including links to open educational resources (e.g. presentations, videos, photos, and links to publications) previously collected in a teaching toolkit.

Macroecological modelling of small-scale phytodiversity patterns to help conserve Palaearctic grasslands

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Eurasian grasslands hold the world records for small-scale plant alpha-diversity, yet they are among the ecosystems most threatened by human impact. A better understanding of the patterns of this diversity and the factors that control it is key to their effective conservation. Local studies have not been able to derive general trends to explain patterns of grassland diversity across regions. One way to overcome this shortcoming is to make use of large data sets that cover a wide geographical area. The GrassPlot database (https://edgg.org/databases/GrassPlot) collects vegetation plot data of grasslands (broadly defined) from the Palaearctic. GrassPlot contains nested plot series or data of eight standard grain sizes: 0.0001, 0.001, 0.01, 0.1, 1, 10, 100, 1,000 m². It also collects a wide range of in-situ measured environmental variables. It currently stores data for >200,000 georeferenced plots throughout the Palaearctic. The aim of the present study is to determine the drivers of alpha-diversity of vascular plants, bryophytes and lichens in Palaearctic grasslands at different scales using data stored in GrassPlot, supplemented by environmental data retrieved from open access global databases. We included a wide range of topographic, climatic, edaphic, anthropogenic and historical parameters as predictors of richness in generalised linear mixed models.

Trait occupancy of ants, butterflies, carabid beetles, grasshoppers and vascular plants along an elevational gradient

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Understanding how species assemble into communities has been a major focus of ecological research, traditionally analyzed through simple indicators like species richness and Shannon diversity for alpha diversity and more complex indices for beta diversity components such as turnover and nestedness. Recently, a multidimensional approach, the hypervolume concept, has been revised to allow characterization of communities using distance metrics and kernel density estimates. Recent studies have employed this concept to understand functional niche space, predict ecological strategy losses, and study ecosystem stability. Comparing hypervolumes can help to reveal spatial variations in species assemblages across different elevations. In our Long-Term Socio-Ecological Research (LTSER) site, Matschertal/Val di Mazia, we studied an elevational gradient from 1000 to 2500 m a.s.l., collecting data on arthropods and plants. Despite challenges in obtaining trait information for some species, we analyzed four distinct traits for each species group at four elevational steps using the hypervolume concept. Our study aims to advance understanding of how elevation influences species trait space and to shed light on ecological processes in mountainous landscapes. These findings have significant implications for predicting species responses to climate change and informing conservation strategies in mountain ecosystems.

Festuco-Brometea grasslands as source of forage for bees: preliminary study on phenology and seed germination in Conero area (Marche Region)

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The Seeds&Bees project, funded by Cariverona-Habitat, aims to restore pollinators habitat in Conero Regional Park, in central Marche Region. Targeting areas include grasslands of Festuco-Brometea class (6210* Habitat), that are in a bad preservation status because of unmanaging. Restoring activities will include shrubs removal, seeding local species, re-introduction mowing. The goal is identifying some bees-attractive species native of Festuco-Brometea vegetation in Conero areas, that can be locally collected and propagated to create commercial seed mixtures. Phytosociological surveys identified Convolvulo elegantissimi-Brometum erecti Biondi 1986 and Centaureo bracteatae-Brometum erecti Biondi et al.1986 plant communities in Conero grasslands. Literature data about foraging species for honeybee and wild bees was used to identify the "apistic interest" (A.I) of some species in those phytocoenoses: among others, Carlina corymbosa L., Centaurea jacea subsp. gaudinii (Boiss & Reut.) Gremli, Convolvulus elegantissimus Mill., Lotus hirsutus L., Echium vulgare L., Sixalix atropurpurea (L.) Greuter & Burdet, have the highest value of A.I. Synphenological surveys were taken in account to identify the annual trend of flowering intensity of these phytocoenoses, that have a typical trend (first maximum at first half of May, second maximum in half July, minimum in early September and upward in early October). Phenological surveys of single species were used to identify flowering periods and the start of dissemination stages for seeds collection. At the current stage of the project, the germinability characteristics of the species are also tested, started from those for which there are no data available in literature, e.g., germination of Lotus hirsutus seeds. Such data can be useful to consider the adaptative strategies of the species and their potential use in seeds mixture for restoration practices, but more information, such as the adaptation to field cultivation, should be taken in account.

Assessing the impact of management practices and nitrogen deposition on grassland plant diversity across Europe

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Identifying the drivers of plant diversity is crucial for conservation and ecosystem management, especially under anthropogenic pressures and climate change. Grasslands, vital for European ecosystem services, are threatened by agricultural intensification and land use changes. We examined the effects of grazing practices and nitrogen (N) deposition on grassland plant diversity across Europe. We explored these links while considering variation in land use cover and biogeographical regions. We used a dataset of ~130,000 plant relevés from the European Vegetation Archive (EUNIS habitat type Grasslands). N deposition was obtained by spatial disaggregation of Common Agricultural Policy Regional Impact Analysis (CAPRI) model outputs. The information on grazing pressure was obtained from datasets that, for the first time, separate indoor and outdoor livestock density at the European scale. Integrated Nested Laplace Approximations (INLA) within the Stochastic Partial Differential Equation framework were used to model spatial dependencies and complex interactions. This modelling method allows fine-scale spatial variability to be captured, providing unbiased estimates on the effects of grazing and N deposition on plant species richness and functional diversity. Preliminary results for plant species richness show negative impacts of cattle grazing intensity and N atmospheric deposition, but a positive impact of caprine grazing intensity. However, results also showed strong variations across biogeographical regions and land use categories, which need to be further analysed to confirm the generalisability of the impacts of management practises on grassland plant diversity. Climatic factors such as temperature and precipitation further influence these relationships, highlighting the complex nature of biodiversity responses to environmental drivers. Our study employs spatial modelling on a large-scale plant diversity dataset, combined with unprecedented grazing intensity and N deposition data at the European level. The findings underscore the importance of considering multiple interacting factors in biodiversity assessments and offer insights for land management and policy-making to preserve grassland diversity under changing environmental conditions across Europe.

Grasslands as key habitat for protected invertebrate species in South Tyrol

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The Habitats Directives was adopted in 1992 and aims to protect habitats and wild flora and fauna throughout Europe, especially by enabling the creation of protected areas as part of the Natura 2000 network. Grasslands are essential habitats for most invertebrates protected at European level, i.e. under the Habitats Directive, particularly for butterflies. But also, invertebrate taxa of other taxonomic groups rely heavily on the maintenance of grasslands, such as the orthopteran Saga pedo, which is also present in Italy. In 2023, the 'Species Monitoring' project was initiated in close collaboration with the Office for Nature of the Autonomous Province of Bolzano, with the aim of monitoring the species included in the Habitats Directive. In South Tyrol the protected species Phengaris arion, Parnassius apollo and Euphydryas aurinia are present and they are typical for open habitats, i.e. extensively managed pastures or hay meadows, in combination with sufficient nectar resources for the adults and host plants for the larvae. Monitoring is performed on specific areas and distribution maps are currently being updated for these three butterfly species. A rare species of snail can also be found in humid calcareous alpine grasslands: Vertigo genesii, included in Annex II of the Habitats Directive. This species is currently known in Italy only from the province of Bolzano. The region therefore has a major responsibility for protecting this species and a long-term monitoring on at least 20 occurrence sites has been initiate in 2024. With this poster we show the monitoring efforts for the protected invertebrate species that rely on the maintenance of mostly extensive and diverse grasslands in South Tyrol.

A link between species abundance and plant strategies for semi-natural dry meadows

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Due of the potential of species to determine ecosystem properties, it is important to understand why some species dominate the plant community and how the abundance of dominant species influences community assembly, biodiversity and ecosystem function. Using vegetation surveys (25 m2) on 35 extensively used dry meadows in north-east Slovenia, we defined dominant (8 species) and subordinate (61) species; they were compared on 14 plant traits to test for significant differences in community weighted mean (CWM) and functional diversity (FD). We found that the dominant and the subordinate species differed strongly in their functional traits. Dominants showed higher leaf dry matter content (LDMC), a more pronounced stress tolerant (S) strategy, they were all clonal with a large proportion of species with rhizomes and a rich bud bank in all layers, while other species had higher specific leaf area (SLA) values, a longer flowering period and more species classified as ruderal (R). For most traits, functional diversity was higher in subordinate species. Our results suggest that dominant species influence the structure of the studied grassland communities by limiting susceptibility to non-competitive processes. They support previous hypotheses that dominant species (which are constrained by the environment) may have a stronger positive effect on some subordinate species by mitigating environmental stressors that normally constrain subordinate species. Subordinate species are able to assemble together by being dissimilar and therefore use different fine-scale niches that are engineered and homogenised by dominant species. Our results show that there are fundamental differences in the relative importance of ecological processes between dominant and subordinate plants in species-rich dry grasslands, which is also important for their conservation and management.

Drone-Assisted Phytosociological Surveys

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Phytosociological maps are crucial for biodiversity preservation within the EU, but conventional methods for their update are labor-intensive and slow. Currently, remote sensing data and machine learning algorithms provide substantial opportunities for more effective vegetation mapping. However, their effectiveness depends greatly on the availability and quality of reference data. This research explores the use of drone technology combined with the Braun-Blanquet phytosociological method to improve the quality of reference data and decrease the time and resources needed for field surveys. To achieve these objectives, we standardized drone procedures to obtain high-resolution images of forest and grassland vegetation, aiming to replicate traditional field surveys. The study covered the forest and grassland areas of Mount Conero and Mount Valmontagnana, both significant for their biodiversity within the Natura 2000 network. Our approach uses standardized methods to identify and capture the main variations in vegetation within a chosen area. To guarantee detailed observations, we utilize drones equipped with optical telephoto lenses specifically selected for their ability to capture details even from moderate distances. In both forest and grassland scenarios, drone imagery was analyzed to identify plant species and assess their abundance, emulating the Braun-Blanquet cover-abundance scale. Our study applied multivariate statistical methods, including the Mantel test and supervised k-means classification, to compare drone survey data with traditional methods. Results showed strong correlations between drone-derived data and traditional field surveys in both forest and grassland settings. Principal component analysis showed similar floristic gradients in both datasets, further confirming the effectiveness of the drone approach. These findings highlight the potential of standardized drone procedures to provide reliable reference data, offering a cost-effective alternative to traditional ground-truthing and paving the way for more precise and updated phytosociological maps. Integrating drone technology with traditional phytosociological methods represents a valuable approach for supporting ongoing monitoring and conservation of forest and grassland biodiversity.

Germination capacity of Central-European dry grassland species after warm and cold conditions: a laboratory experiment

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Seeds have a crucial role in maintaining grassland biodiversity in space and time. The ability of seeds to germinate is determined by many factors, including seed dormancy, which can hamper seed germination immediately after seed dispersion, to avoid unfavourable conditions. Seed dormancy breaks following certain conditions, like after a period with appropriate temperature. In our study we aimed to test the effect of different temperature conditions, which mimic present and predicted summer and winter conditions, on dormancy breaking and germination capacity of 44 dry grassland species. We applied fifteen different stratification treatments under laboratory conditions, which included 1-3 months of warm dry stratification (summer heat), 1-3 months of cold wet stratification (winter) and the combination of the two (summer heat followed by winter). We found that four species were not influenced by any of the stratification treatments. Three species germinated better after cold wet stratification while one species was hampered by the cold conditions and germinated only after warm dry stratification. Seven species showed negative response only after a prolonged cold period following the warm periods, while three species showed the opposite trend. Based on our results we were able to determine conditions that breaks dormancy in some of the species and those conditions that prolong it. We were also able to categorize the studied species into fall- or spring-germinating species. Our results are of great importance as can help in planning successful restoration projects by seed sowing, that optimize seed sowing period and use pretreatments if needed to increase establishment success of dry grassland species.

Identifying ecological corridors of the bush cricket Saga pedo in fragmented seminatural-grasslands.

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The bush cricket, Saga pedo, currently listed as Vulnerable globally by the IUCN and included in Annex IV of the European Union Habitats Directive, is a parthenogenetic species, highly sensitivity to environmental changes and thus facing threats due to the expansion and encroachment of forests as well as the intensification of agriculture. Indeed, S. pedo prefers dry and open habitats with sparse vegetation, and due to its pronounced thermophily and heliophily, it occurs in xerothermic patches, thereby establishing itself as a primary insect indicator of these habitats. Semi-natural grasslands are highly fragmented in many areas of Italy, including the Northern Apennines (Piedmont, Italy) where we carried out this study. Here, open habitats have been reduced to small and isolated patches surrounded by forests due to the abandonment of agropastoral activities such as mowing and extensive grazing. Consequently, the occurrence of open habitat-species in these territories is related to the quality and availability of suitable areas, as well as ecological connectivity between the remaining open patches. To identify areas of occurrence for the predatory bush cricket, S. pedo, we applied spatial site occupancy models and then used the inverse of the resulting probability of occurrence to derive ecological corridors among suitable patches for this species. In conclusion, given the risk of extinction S. pedo is facing in our study area, we urgently advocate the intervention of local administrations and managers to maintain and possibly improve suitable areas for conservation and guarantee the network of ecological corridors, identified in our research.

Practical test of the regulation of Colchicum autumnale in the Biosphere Reserve Wienerwald, Lower Austria

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Colchicum autumnale is a highly toxic plant species, which can be found in species-rich grasslands in the southern parts of Central Europe. In Austria it is typical for sites with a changing water supply. Although poisoning of small animals like rabbits and even of humans occur quite frequently, problems with farm animals like cattle, sheep and horses are recorded rather seldom. There seem to be mechanisms about animals learning not to eat this plant, neither on pastures, nor in the hay. Nevertheless, the plant has become a main problem for grassland farmers in some parts of eastern Austria, especially in the Wienerwald region, where they have become highly dependent on selling hay to horse keepers. As a result, in some parts of Lower Austria high densities of C. autumnale may endanger the management of species-rich grasslands. In the time around 2010, studies on population biology of C. autumnale were carried out by a team from the University of Natural Resources and Life Sciences, Vienna (BOKU). They suggested a strong effect of additional early mowing against the population of the species. From 2018 to 2022 we conducted a practical test of this method together with 12 farmers from the region. On 18 plots with high densities of C. autumnale regulation was carried out in a practical way, mostly either by mowing with a typical mower or with a flail shredder, usually in late April or early May. There were also reference plots without the regulation nearby. The density of C. autumnale was counted on plots with a radius of 3 m within the meadows. Additionally, 12 permanent plots with species lists and coverage were applied. During the project, changing densities of the populations of C. autumnale could be found for different reasons, mainly because of changing weather conditions from year to year. There was only one plot with a clear decline of density, where probably also other factors of the management were changed. Although there were no clear scientific results on effects of regulation, it showed the importance of integration farmers knowledge and their practical possibilities in the development of suggestions for grassland management. At least the resampling of the permanent plots showed a clear result. The biodiversity of the grasslands was not reduced by the regulation.

Educational activity to sensitize children on grassland biodiversity conservation, animal welfare and social utility of research

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Study aim was to explore children's knowledge and level of awareness to 3 general concepts representing the 3 project's pillars grassland biodiversity, animal welfare and the social utility of research, by means of an observational study involving 252 students of both genders, aged between 9 and 11. The educational activity was organized in 3 meetings; interactive ppt presentations about the project topics were proposed, followed by ludic activities to enable the children to review the concepts discussed during the theoretical parts. Two different types of tests referred to as "attitude questionnaire" (AQ) and "maximum performance test" (MPT) were administered during the project. The AQ was administered before the start and at the end of the project to assess both the children's sensitivity to the treated topics and their awareness toward the project's pillars. The test consisted of 15 items; for each item children could express their degree of agreement/disagreement by choosing from 1 to 5 score to obtain useful data for statistical processing. Cumulative Link Mixed Models were used to test for the effects of the various explanatory variables on the children's responses. Data were analyzed in R Studio using the "lme4" package. The MPT aim was to evaluate if children had understood the topics explained during the meetings in the immediate term. Each test contained sentences about the specific meeting topics, respondents had to choose between "true" or "false" options. The correlation between MPT score and school Science evaluations of each child was analyzed. Among the 5 items for each pillar, 4 items related to biodiversity, 3 items related to animal welfare and 2 items related to social utility of research, showed a significant difference in the second AQ responses. The analysis of data from the MPT showed that the didactic methodology used was effective and improved the position of most of the children bringing them into higher Science evaluation groups. The children's awareness of the topics increased and showed the effectiveness of dissemination in Citizen science activities. The children expressed their thoughts and appreciation through pictures and nursery rhymes, and someone expressed their intention to care for animals, protect biodiversity and to become a scientist.

Managment at the old cemeteries Right-Bank of Dnipro Grass Steppe (southern Ukraine)

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Anthropogenic activities have led to a significant loss of natural habitats worldwide over the past centuries (Löki et al. 2019A) and in Ukraine. Large-scale destruction of steppe ecosystems occurred in Ukraine during the Soviet era, when almost all the plain steppes were cultivated and the area of steppe vegetation decreased by a factor of 40 (Burkovskyi et al. 2013). Old cemeteries, in our understanding, are cultural heritage sites established more than 100 years ago on or near virgin steppe land, within natural steppe habitats, before the significant transformation of the steppe cover and massive ploughing in the early 20th century (Europe Council, 2000). The preservation of the steppe and the rare flora of the old cemeteries was made possible by the respectful attitude towards burial sites in Ukraine, and thus at least some parts of the old cemeteries may have remained intact for centuries, despite the relatively high anthropogenic pressure within such sites. We investigated 50 old cemetries in the Right-Bank of Dnipro Grass Steppe Distirct (southern Ukraine) (National Atlas… 2007). The territory includes parts of Dnipopetrovsk, Kherson, Mykolaiv and Odesa administrative Regions The list of flora of old cemeteries includes 659 species of cascular plants, of which 52 have a conservation status. One of the problems of preserving biodiversity in old cemeteries is the lack of steady management. Modern management of old cemeteries in Ukraine does not have a clear management plan. Although we have observed grazing, mowing and burning in old cemeteries provided by local communities. We propose that the steppe flora of old cemeteries should be conserved by proper management. In particular, mowing and grazing of tree and shrub vegetation would be most appropriate in accordance with land use.We believe that it is not ethical to use the latter mowing and burning of management in these cultural heritage sites. The research was supported by IAVS Special grant to support the research of Ukrainian members ”Plant diversity and species-area relationships modelling of steppe enclaves within old cemeteries of Northern Prychornomoria region (Northern Black Sea Region) of Southern Ukraine”.

CAROLINA ClimAte Resilience Over Landuse change In semi-Natural grasslands

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Grasslands represent species-rich plant communities in Europe and their loss is one of the primary causes of terrestrial biodiversity depletion in the Mediterranean Basin. In Italy the abandonment of agro-pastoral activities has an important role in this process, leading to the wood encroachment and loss of grasslands cover. Furthermore, one hypothesis is that grazing makes the system climate-resilient by diversifying the ecological niches. The project CAROLINA aims to explore the potentiality of the grassland's extensive management under different climate conditions in terms of biodiversity conservation and C sequestration and to examine changes in ecosystem resilience to climate change with land-use variation. In this project 3 sites are object of both remote sensing studies on ecosystem scale and taxonomic and functional biodiversity analyses. They are located in different climatic zones of Italy: alpine pastures with moist cool climate (Pieve Tesino), Mountain-Mediterranean pastures (San Rossore) and Mediterranean pastures with warm and dry climate (San Venanzo). A chronosequence approach is used to evaluate the impact of grazing and abandonment, considering areas abandoned in different time frames. Portions of grasslands in each site are excluded from grazing through the installation of fences to evaluate short-term changes while small portions of grazed areas are object of climate manipulation with structures that lead to a reduction of precipitation, to simulate the future climate trends expected for Italy, different for each site, considering local climate characteristics. About vegetation, the focus is on the connections between functional and taxonomic diversity and physiological characteristics, indicative of possible long-term changes in the community. The niches diversification grade and climate adaptability along the chronosequence is assessed by plant communities' functional and taxonomic diversity and remote sensing is applied to link changes in plant and soil diversity with the multispectral diversity. The surveys in the year 2024 are a zero-point allowing to assess the diversity and functioning of the grasslands before the start of the manipulations that will simulate the removal of grazing and the decrease in water availability.

Species-rich meadows as donor areas for seed production of native herbaceous species in South Tyrol

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Land-use change has led to a decrease of plant species diversity on farmland. At present, commercial seed mixtures for ecological aims contain ecotypes from other geographic regions, cultivars of agricultural relevant species or non-native species because of low price and easy availability. In order to make seed mixtures with higher ecological value available in South Tyrol, the project Regional Seeds of Laimburg Research Centre started in 2023 with seed collection of ecotypes of native vascular plants in species-rich meadows. The aim of this ongoing project is the production of seeds for flower-rich stripes in field margins, embankments and crop interrow to enhance local biodiversity in orchards and vineyards. From a network of extensive meadows monitored by Eurac Research, three donor sites were chosen in 2023 and six in 2024. The plant communities consisted of more than 1000 individuals per species. In order not to endanger the plant population of the meadow, only 100 flower heads per species and just once in the two collection years were harvested. So far, 27 different species were collected with the main focus on Carum carvi, Knautia arvensis, Leucanthemum vulgare, Lotus corniculatus, Onobrychis montana, Plantago lanceolata, Salvia pratensis and Trifolium pratense. Species were chosen based on insect attractiveness, soil amelioration potential, easiness of propagation and moderate sale price using information from literature as a source. After manual harvest, the seeds or ripen inflorescences were dried with different methods depending on seed amount and moisture: drying cabinet, desiccator or at room temperature. After cleaning, the seeds were stored at 8°C with constant humidity. In early spring, seedlings were grown up in the greenhouse and were planted in a propagation field in Pfatten and in Eyrs. To represent the genetic range of South Tyrol, each propagated species corresponded to a mixture of all harvested provenances, in order to decrease the risk of negative effects of genetic drift and low genetic variability resulting in low adaptability to the environmental conditions of the target site. Depending on the species, 0.4 to 170 g of seeds per species were collected in the first year, yielding seed amounts being 526 times the collected seed.

The orchid species diversity of Makovytsya mountain (Ukraine)

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Many species of Orchidaceae (Juss.) family have vulnerable or endangered status in Eastern and Western Europe. Among the main factors which influence on distribution of orchids are ecological, biological and anthropogenic. Usually, the ways of orchid conservation include research connected with taxonomy, geographic distribution, impact evaluation of ecological and antropogenic factors on orchid populations. The present study of Orchidaceae family was carried out on Makovytsya montain from June 2016 till September 2021 by rout-field method. Author made 10 observations and identified 7 species. The recent protective status for each identified variety was evaluated according to Red book of Ukraine and IUCN Red List categories of vascular plant species of the Ukrainian flora. Following species were identified: Neotinea ustulata (status Vu – national category; LC – global category; e – Red book); Dactylorhiza maculata (LC – national category; LC, – global category; v – Red book; D. fuchsii (LC – national category; LC – global category; ne – Red book); D. majalis (LC – national category; LC – global category; r - Red book); Gymnadenia conopsea (LC – national category; LC – global category; v- Red book); Platanthera bifolia (LC – national category; LC – global category; ne - Red book); Epipactis helleborine (LC – national category; LC – global category; ne - Red book). The obtained geolocation data with photos were deposited in iNaturalist database. The following information was included into project Wild Orchids of Western Palearctic. Then the analysis of data, dedicated to Orchidaceae species distributed on Makovytsya mountain, deposited in iNaturalist & Ukrbin databases was conducted. According data presented in iNaturalist for Makovytsya mountain no additional identifications of other orchid species was made. According information in Ukrbin – only 5 species with 6 localities were mentioned for Makovytsya mountain: E. helleborine, G. conopsea, N. ustulata, P. bifolia, Traunsteinea globose. Thus, the further studies of orchids distribution on this region should be made.